WINING
广州市艾禧电子科技有限公司
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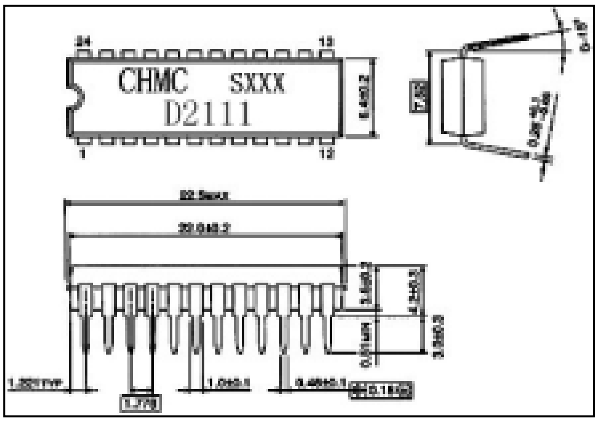
调频调幅立体声收音机电路　　D2111

概述：

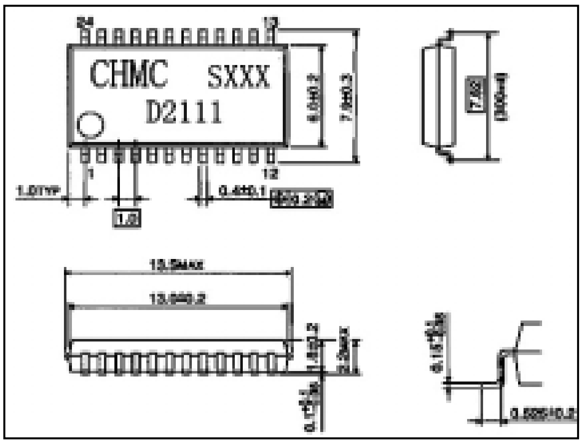
D2111 是单片 FM/AM 立体声收音机电路。调幅部分内含混频、本振、中放、检波、AGC 电路及低频放大器，调频部分包含了从高频级至 FM 立体声解码左右声道音频输出的全部功能。外接一块双声道音频功放电路，就可以组成一部完整的FM/AM立体声收音机。可用于低压便携式FM/AM立体声收音机或 3V 耳机收音机。

采用 SDIP-24 或 SSOP-24 封装形式。

封装外形图



SDIP-24



SSOP-24

主要特点：

- 具有新型防磁幅射功能。
- 无需 AM 检波线圈、FM 中放线圈、IF 耦合电容。
- 采用陶瓷鉴频器，无需调节 FM 中周。
- 内置 FM MPX 压控振荡器。
- 内置变容二极管，用于自动频率控制电路。
- 内置 19kHz 锁相电路，采用电阻熔断方法调样频率。
- 内置低通滤波电路。
- 功耗电流低：(Vcc=3V, Ta=25°C)
  Iccq(FM)=9.0mA (典型)
  Iccq(AM)=5.0mA(典型)
- 工作电压范围：Vcc=1.8~7V(Ta=25°C)。

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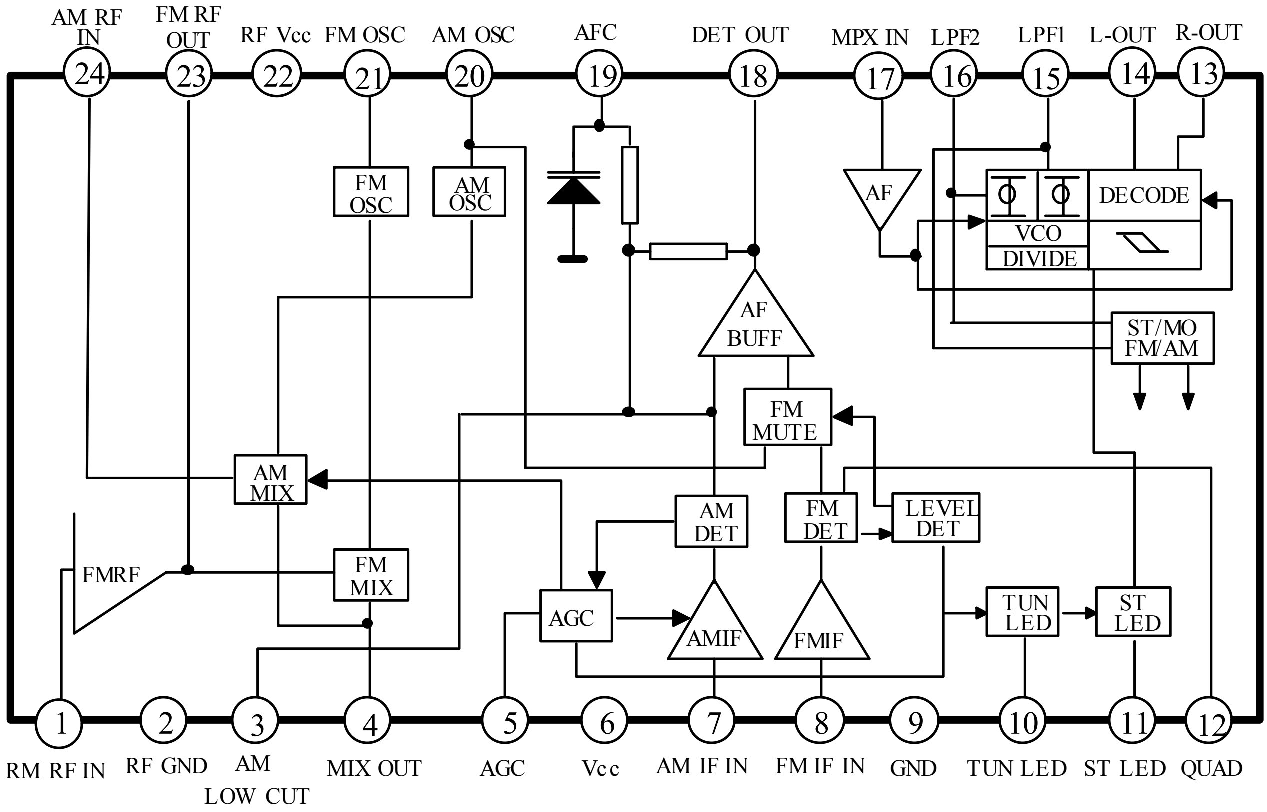
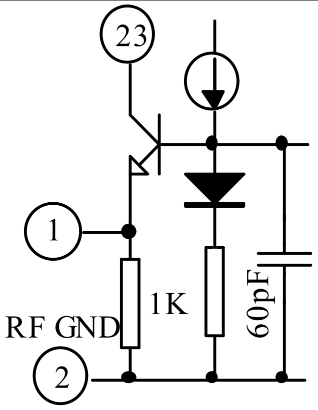
功能框图和管脚排列图



引出端功能符号

引出端序 号	特性	内部电路图	引脚电压(V)(典型)	
			AM	FM
1	FM-RF IN		0	0.8
2	RF GND (FM RF, FM OSC 部分地)	-	0	0

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引出端功能符号

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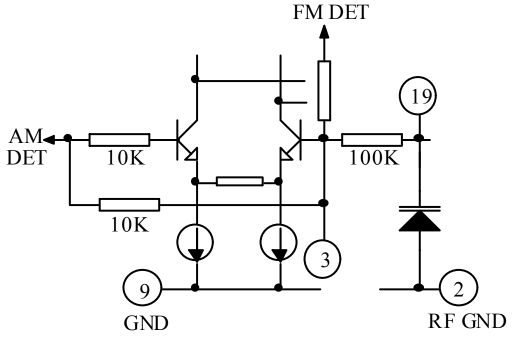
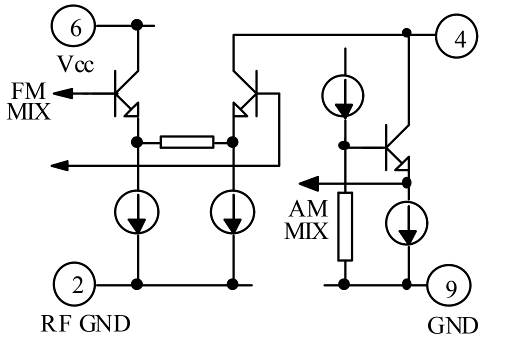
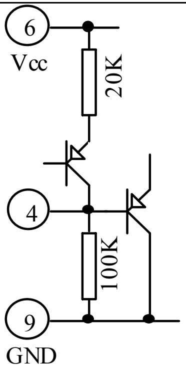
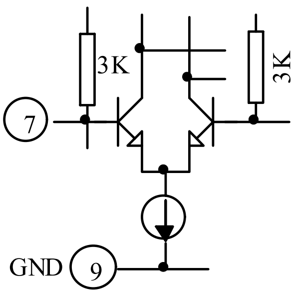
引出端序 号	特性	内部电路图	引脚电压(V)(典型)	
			AM	FM
3	AM LOW CUT		1.0	0.8
4	MIX OUT		3.0	2.9
5	AGC (AM AGC)		0	0
6	Vcc(AM, FM IF, FM MPX 部分电源)	-	3.0	3.0
7	AM IF IN		2.3	2.6

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引出端功能符号

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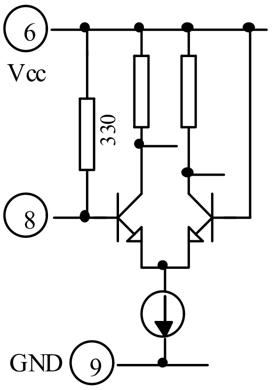
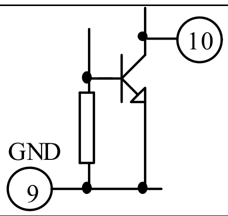
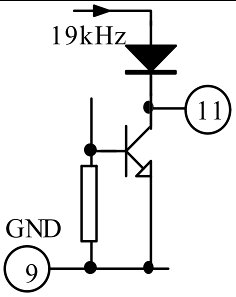
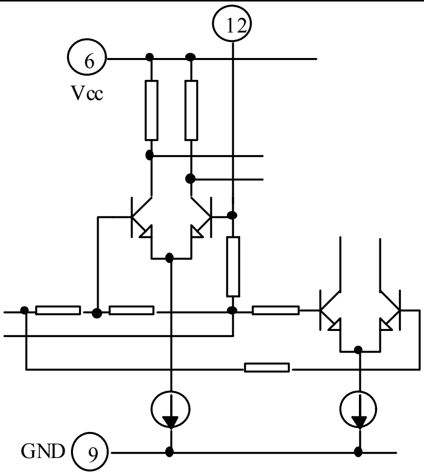
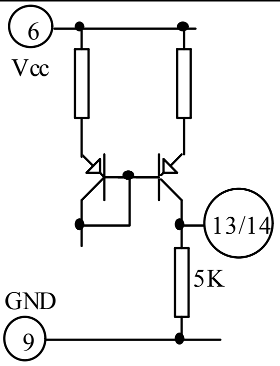
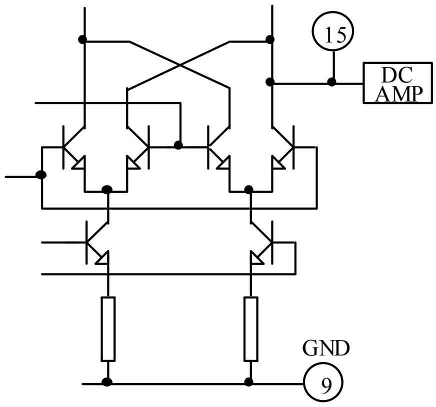
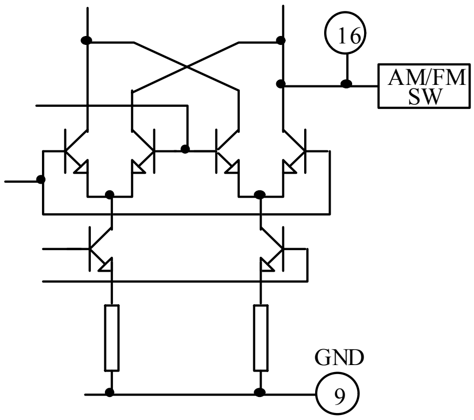
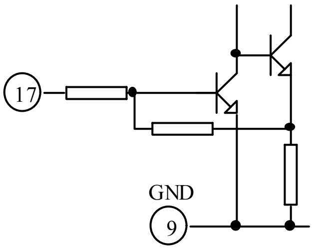
引出端序号	特性	内部电路图	引脚电压(V)(典型)	
			AM	FM
8	FM IF IN		2.3	2.6
9	GND (AM, FM IF, FM MPX 部分地)	-	0	0
10	TUN LED (LED 调谐)		-	-
11	ST LED (立体声 LED)		-	-
12	QUAD (FM QUAD，检波)		2.5	2.2

引出端功能符号

续

引出端序 号	特性	内部电路图	引脚电压(V)(典型)	
			AM	FM
13 14	R-OUT (R-ch 输出) L-OUT (L-ch 输出)		1.2	1.2
15	LPF1 ● LPF 端 同步检波 ● VCO 停止端 V15=Vcc→VCO 停止		2.3	2.3
16	LPF2 ● LPF 端相位检波 ● AM/FM SW 电路偏置端 V16=Vcc→AM V16=开→FM		3	2.2
17	MPX IN		0.7	0.7

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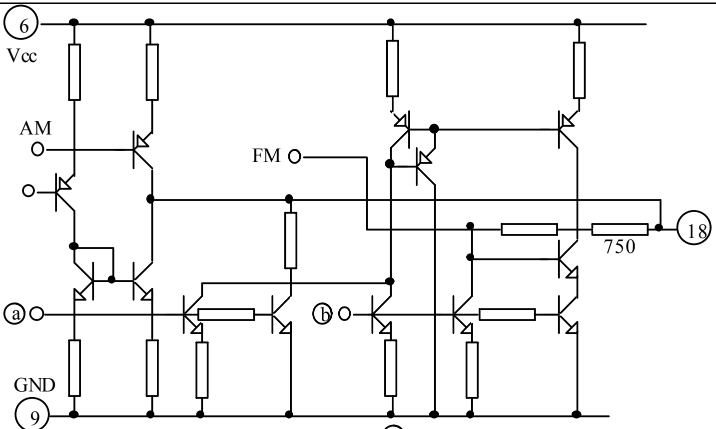
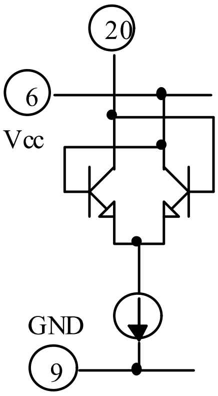
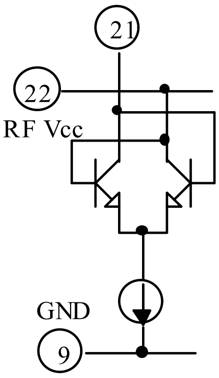
引出端功能符号

续

<table>
<tr><th rowspan="2">引出端
序 号</th><th rowspan="2">特性</th><th rowspan="2">内部电路图</th><th colspan="2">引脚电压
(V)(典型)</th></tr>
<tr><th>AM</th><th>FM</th></tr>
<tr><td>18</td><td>DET OUT</td><td>

ⓐ LOW→FM，HIGH→AM
ⓑ LOW→AM，HIGH→FM</td><td>1.0</td><td>0.9</td></tr>
<tr><td>19</td><td>AFC</td><td>与③脚相同</td><td>-</td><td>-</td></tr>
<tr><td>20</td><td>AM OSC</td><td>
</td><td>3.0</td><td>3.0</td></tr>
<tr><td>21</td><td>FM OSC</td><td>
</td><td>3.0</td><td>3.0</td></tr>
<tr><td>22</td><td>RF Vcc (FM OSC 部分电源)</td><td>-</td><td>3.0</td><td>3.0</td></tr>
<tr><td>23</td><td>FM RF OUT</td><td>与①脚相同</td><td>3.0</td><td>3.0</td></tr>
</table>

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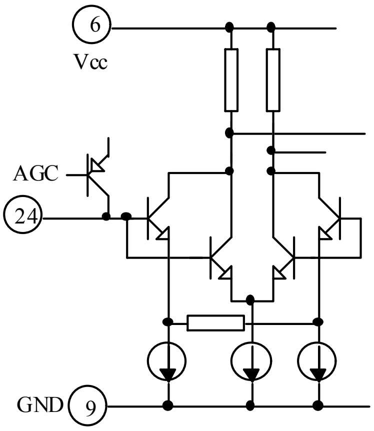
引出端功能符号

续

引出端序 号	特性	内部电路图	引脚电压(V)(典型)	
			AM	FM
24	AM RF IN		3.0	3.0

极限值（绝对最大额定值，若无其它规定，Tamb=25°C）

特性		符 号	数 值	单 位
电源电压		Vcc	8	V
LED 电流		ILED	10	mA
LED 电压		VLED	8	V
功耗(*)	SDIP-24	PD	1200	mW
	SSOP-24		400	
工作温度		Topr	-25~75	°C
贮存温度		Tstg	-55~150	°C

注（*）：在 25°C以上使用时，每升高 1°C，功耗减少 9.6mW(SDIP-24)，功耗减少 3.2mW(SSOP-24)。

电特性 (若无其它规定：Ta=25°C, Vcc=3V;　F/E: f=98MHz, fm=1kHz; FM IF: f=10.7MHz, Δf=±22.5kHz, fm=1kHz; AM: f=1MHz，MOD=30%,fm=1kHz; MPX: fm=1kHz)

特性			符号	测试电路	测试条件		最小	典型	最大	单位
电源电流			Icc(FM)	1	Vin=0, FM 模式			9	12.5	mA
			Icc(AM)	1	Vin=0, AM 模式			5	7.5	
F/E	输入限幅电压		Vin(lim)	1	-3dB 限幅			7		dBμV EMF
	调频本振电压		Vosc	2	fosc=108.7MHz			105		mVrms
FM IF	输入限幅电压		Vin(lim) IF	1	-3dB 限幅		35	40	45	dBμV EMF
	检波输出电压		V_{OD}	1	Vin=80dBμV EMF		60	75	90	mVrms
	信噪比		S/N	1	Vin=80dBμV EMF			65		dB
	失真度		THD	1	Vin=80dBμV EMF			0.2		%
	调幅抑制比		AMR	1	Vin=80dBμV EMF			50		dB
	LED 开灵敏度		V_L	1	I_L=1mA		40	45	50	dBμV EMF
	静噪衰减度		MUTE	1	Vin=0			20		dB
AM	增益		G_V	1	Vin=25dBμV EMF		18	35	70	mVrms
	检波输出电压		V_{OD}	1	Vin=60dBμV EMF		50	70	90	mVrms
	信噪比		S/N	1	Vin=60dBμV EMF			41		dB
	失真度		THD	1	Vin=60dBμV EMF			0.7		%
	指示灯开灵敏度		V_L	1	I_L=1mA		23	28	33	dBμV EMF
18 脚输出电阻			R18	-	FM 模式			0.75		kΩ
					AM 模式			15.5		
MPX	输入电阻		R_{IN}	-				55		kΩ
	输出电阻		R_{OUT}	-				5		kΩ
	最大复合信号输入电压		Vin MAX (Stereo)	1	L+R=90%, P=10%, fm=1kHz, THD=3%			700		mVrms
	通道隔离度		Sep	1	L+R=180 mVrms, P=20 mVrms	fm=100Hz		45		dB
						fm=1kHz	35	45		
						fm=10kHz		45		
	失真度	非立体声	THD	1	Vin=200mVrms			0.3		%
		立体声		1	L+R=180 mVrms,P=20 mVrms			0.3		
	电压增益		G_V	1	Vin=200mVrms		-2.5	-1	0.5	dB
	通道平衡度		C.B	1	Vin=200mVrms		-1.5	0	1.5	dB
	立体声指示灯灵敏度	亮	$V_{L(ON)}$	1	辅助输入			8	12	mVrms
		灭	$V_{L(OFF)}$	1			3	6		
	指示灯迟滞电压		V_H	1	灯亮→灯灭			2		mVrms
	捕获范围		C.R	1	P=20 mVrms			±8		%
	信噪比		S/N	1				80		dB

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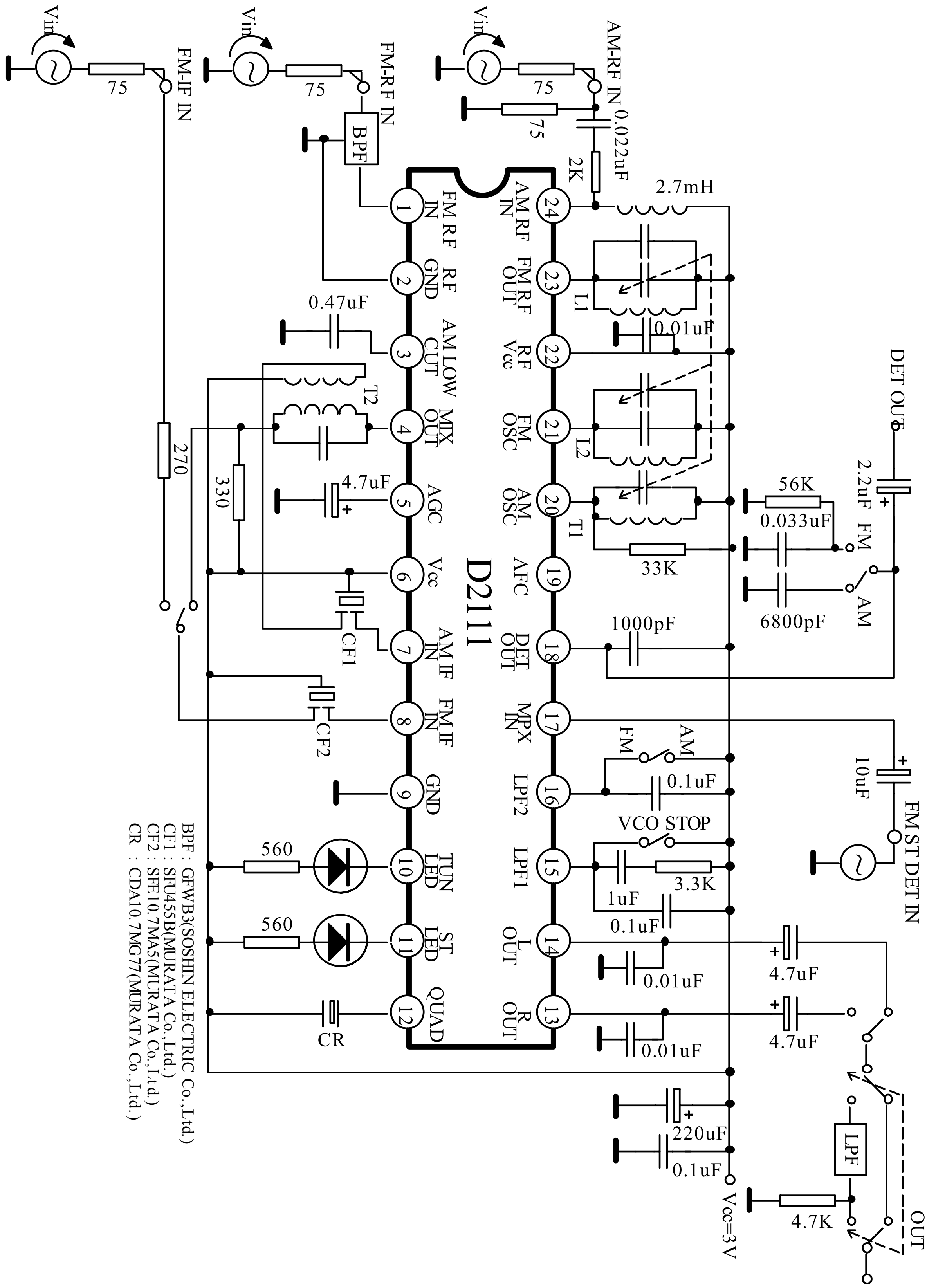
测试原理图 1



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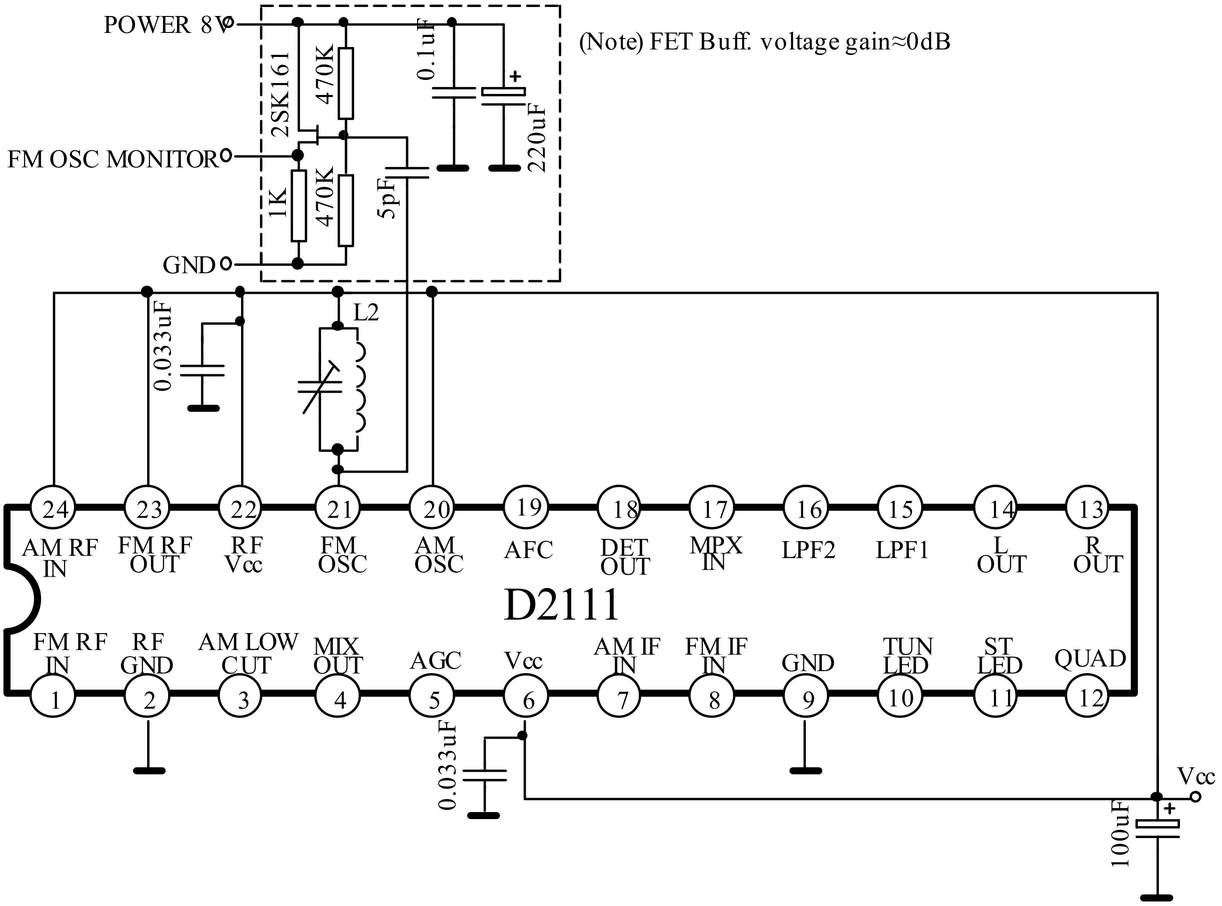
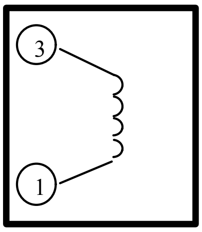
测试电路图 2



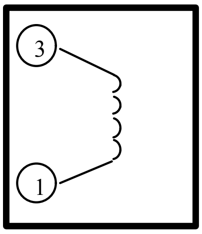
线圈数据

线圈号	测试频率	L (μH)	Co (pF)	Qo	线圈数					线径 (mmϕ)	参考
					1-2	2-3	1-3	1-4	4-6		
L1 FM RF	100MHz			79				2.5		0.16UEW	666SNF-305NK
L2 FM OSC	100MHz			79				2		0.16UEW	666SNF-306NK
T1 AM OSC	796kHz	268		65	19	95				0.05UEW	5PNR-5146Y
T2 AM IFT	455kHz		470	60			109		7	0.05UEW	5PLG-5147X

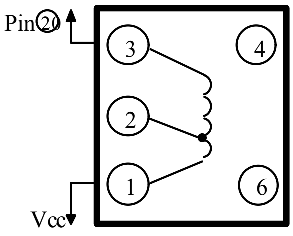
L1: FM RF



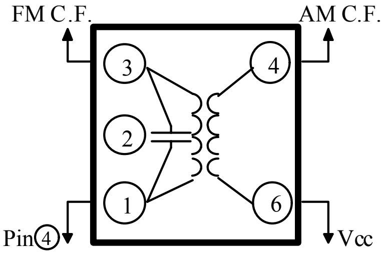
L2: FM OSC



T1:AM OSC



T2: AM IFT



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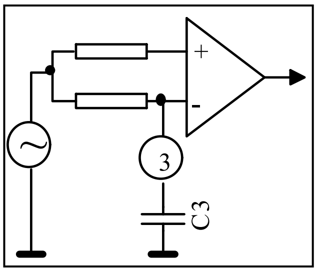
应用要点

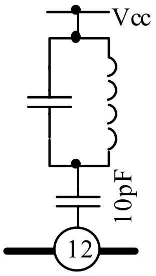
1. 调幅低频截止电路

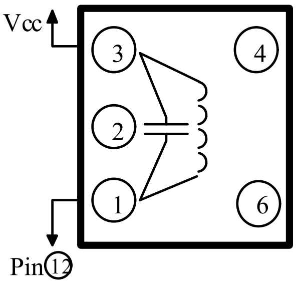


- 调幅低频截止作用通过 D2111 的 3 脚外接电容器 C_3 与内部 AF 放大器的反馈电阻组成的电路实现正向反馈信号高频成分的旁路。
- 截止频率 f_L 由内部电阻 10kΩ和外接电容 C_3 决定如下：$f_L=1/(2\times\pi\times10\times10^3\times C_3)(Hz)$
- 设定 C3 超过 1μF，调幅低截止不起作用。在 $C_3 \geq 1\mu F$ 的情况下，在低频时频率特性产生平坦响应。
- 在 FM 模式，C3 是 AFC 低通滤波电容。

2. 调频检波电路

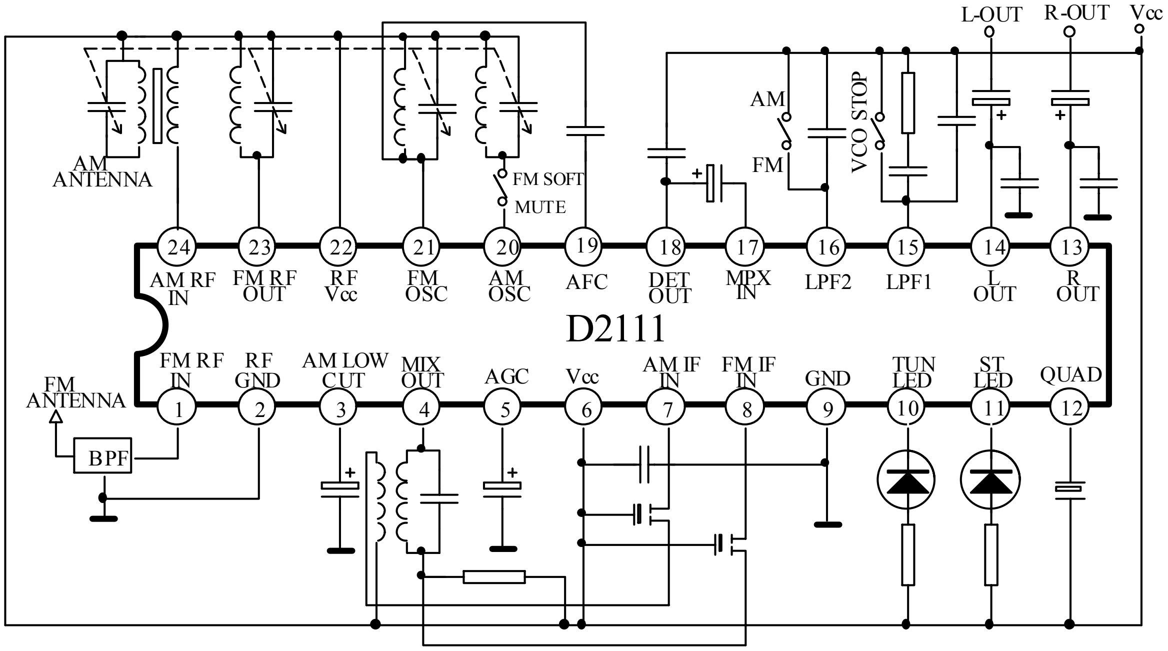
对于调频检波电路，检波线圈可以用陶瓷鉴频器替代。推荐电路和推荐线圈如下。在这种情况下，请注意 Vin(lim.)会有一点下降。





测试频率	Co (pF)	Qo	线圈数				线径 (mmϕ)	参考
			1-2	2-3	1-3	4-6		
10.7MHz	51	45			30		0.12UEW	TOKO Co., Ltd 600BEAS-10018Z

应用图



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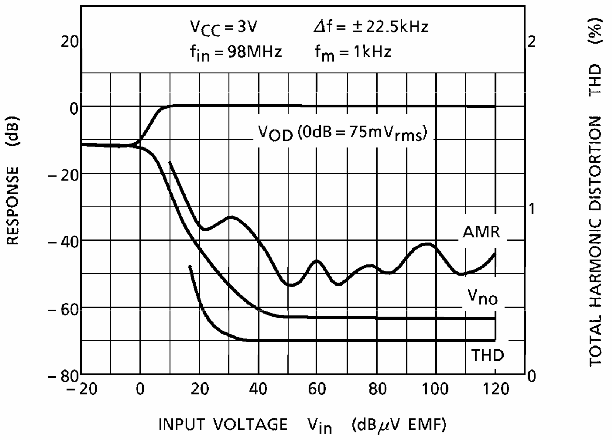
特性曲线

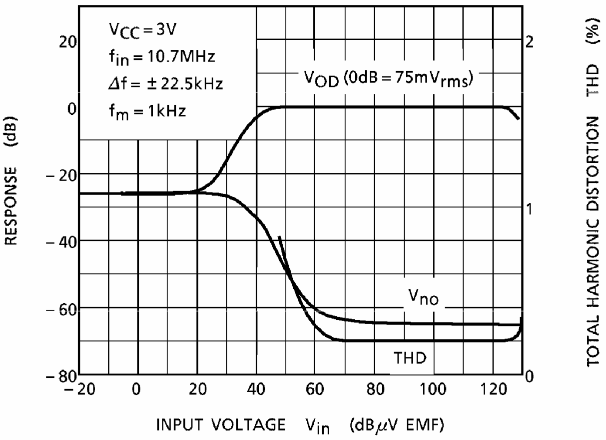
FM (F / E + IF)

V_{OD}, V_{no}, THD, AMR – V_{in}



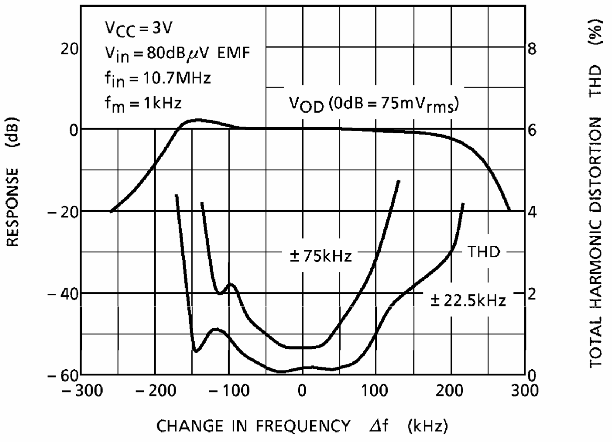
FM (IF)

V_{OD}, V_{no}, THD – V_{in}



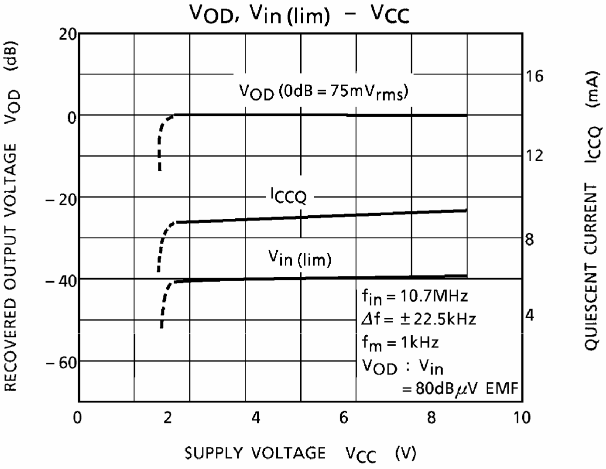
FM (IF)

V_{OD}, THD – Δf



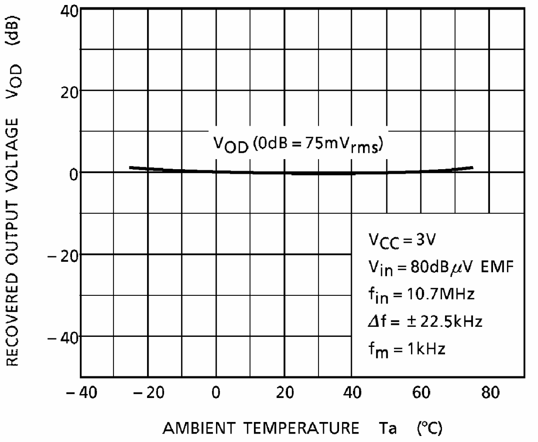
FM (IF)

V_{OD}, $V_{in\,(lim)}$ – V_{CC}



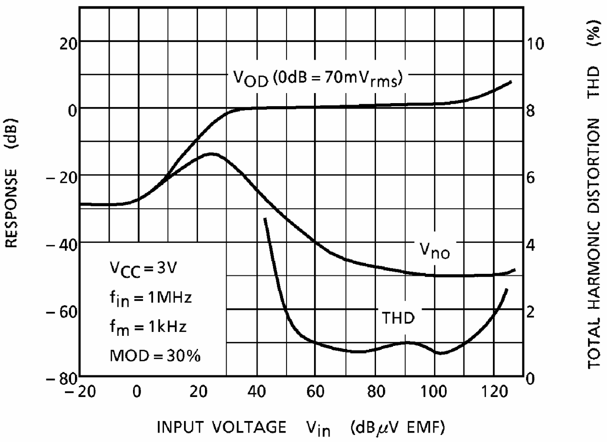
FM (IF)

V_{OD} – Ta



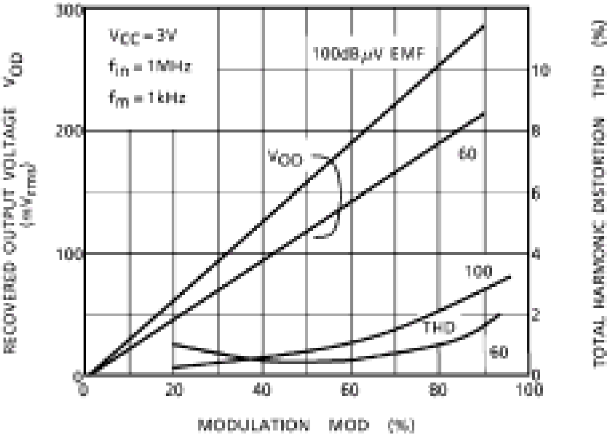
AM

V_{OD}, V_{no}, THD – V_{in}



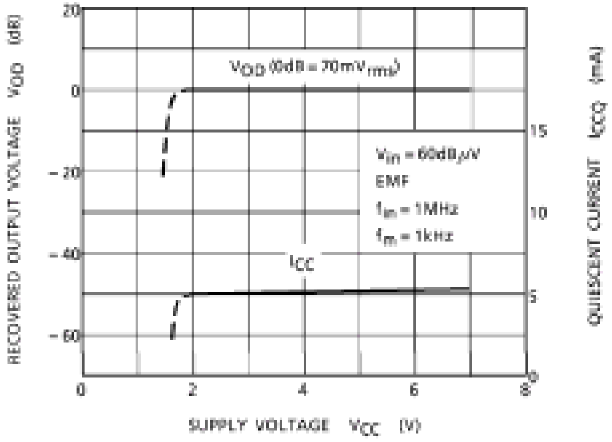
AM

V_{OD}, THD – MOD



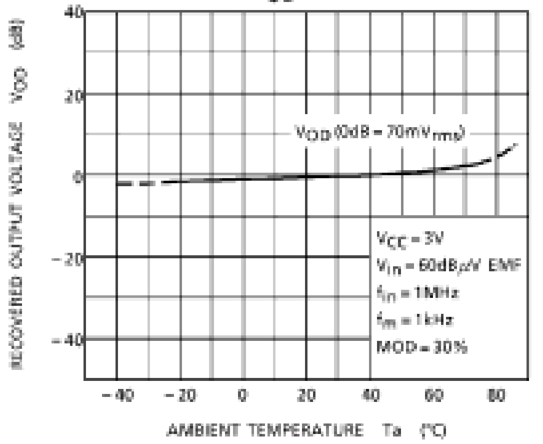
AM

V_{OD}, I_{CC} – V_{CC}



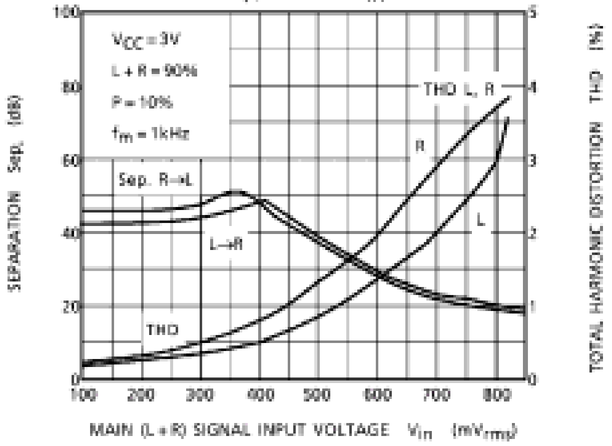
AM

V_{OD} – Ta



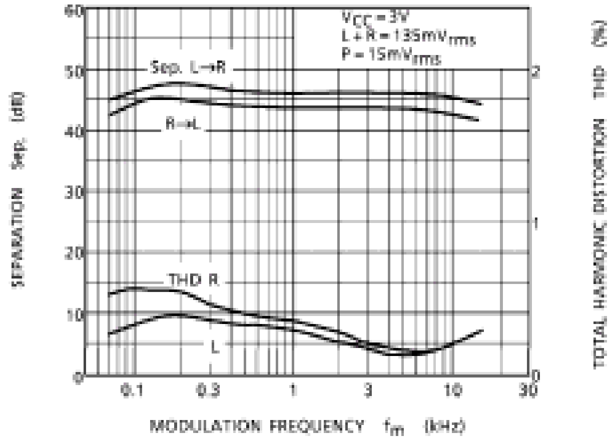
MPX

Sep, THD – V_{in}



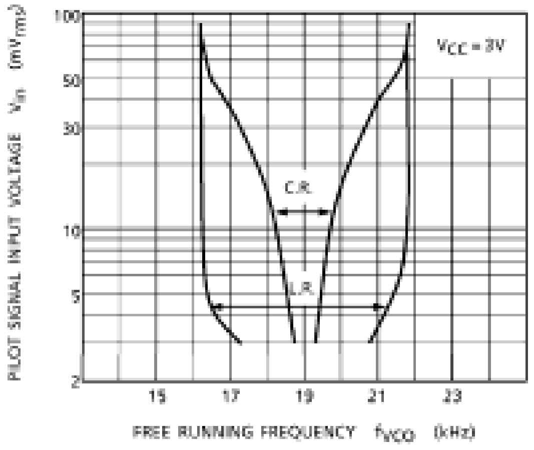
MPX

Sep, THD – f_m



MPX

CAPTURE RANGE & LOCK RANGE



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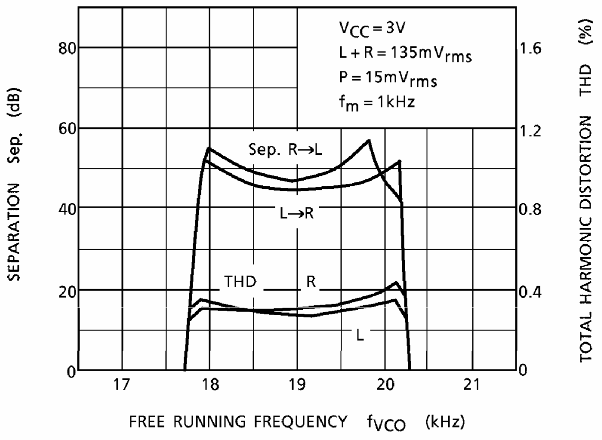
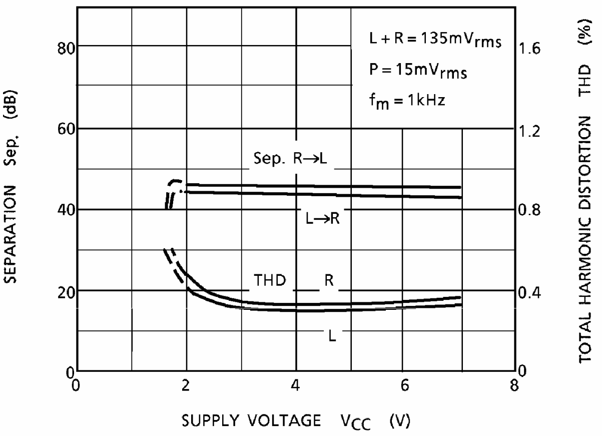
MPX

Sep, THD – f_{VCO}



MPX

Sep, THD – V_{CC}



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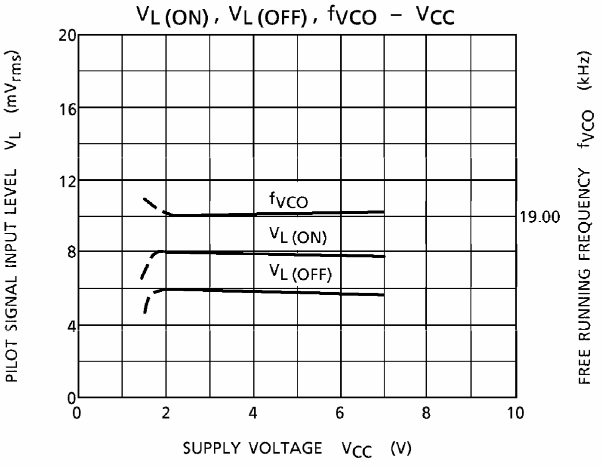
$V_{L(ON)}$, $V_{L(OFF)}$, f_{VCO} – V_{CC}